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Factors affecting infant mortality rates: evidence from cross-sectional data

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This paper empirically tests for factors affecting infant mortality rates. Based on a cross-sectional model (covering 117 countries for the year 1993) that corrects for heteroscedasticity, the results show that fertility rates, female participation in the labour force, per capita GNP, and female literacy rates significantly affect infant mortality rates. Surprisingly, government expenditure on health-care, as a percentage of GNP, does not play a major role in determining infant mortality rates.

I. INTRODUCTION

Easily quantifiable, infant mortality rates serve as excellent health status indicators across and within economies. It is only natural that factors that affect human development in a country also affect infant mortality rates, and vice versa. High infant mortality reflects the lack of proper childcare owing to poverty, lack of education, and societal preferences (such as the affinity for a male child), among others.

Infant mortality rate is a factor that can be associated with the well-being of a population. High infant mortality rates could reflect improper childcare. A population with diseased and unhealthy infants who grow up to form sickly adults prone to disease, dampens economic progress in many ways: it decreases worker productivity; it does not allow utilization of natural resources that would otherwise be accessible under good health conditions; it harms the next generation by decreasing enrolment of children in school, and, finally, it increases medical-care expenditure, rendering inefficient allocation of resources (World Development Report, 1993). Thus improved health conditions (clearly manifested in the form of low infant mortality rates) lead to superior economic performance at the national level.

While programmes to curb infant mortality have been instituted in several countries (by providing maternity benefits and educating mothers about child health care and nutrition), the results are still far from desired. However, alienating and focusing on factors that affect infant mortality may result in increasing the efficiency of such programmes. In this paper, we try to identify these factors using cross-section data from 117 countries, both developing and industrialized. Specifically, we study the effects of fertility rates, per capita GNP, female share of the labour force, female literacy rates, and government expenditure on health care as a fraction of annual GNP on infant mortality rates.

II. THE SIMULTANEITY HYPOTHESIS

Studies (Bhattacharya *et al*., 1995 and Winegarden and Bracy, 1995) have shown that fertility rates and infant mortality rates are closely related. A high fertility rate (i.e., the number of children borne by a woman), often results in the poor health of the mother. Later pregnancies among physically ill mothers then result in malnourished and diseased children whose chances of survival are drastically reduced both before and after birth (Birdsall, 1988).

However, Chowdhury (1988) has suggested that there is a dual causality between infant mortality rates and fertility rates. He believes that when a woman has multiple pregnancies, the chances of her child's survival are significantly reduced. A woman may thus decide to bear more children in the hope that at least some will stay alive.

On testing for such a simultaneity[1] we found that fertility rates do indeed have an impact on infant mortality rates and

[1] Test for possible simultaneity between *IMR* and *FERTILITY*, a two-step procedure of the Hausman (1978) specification test proposed by Spencer and Berk (1981) is performed. In the second stage of the *IMR* equation, the residual (*R*) from the reduced form equation of *FERTILITY* is added as an extra regressor. The variable *R* was indeed statistically insignificant implying lack of simultaneity between *IMR* and *FERTILITY*. To conserve space full regression results for the Hausman test are not included in the paper but can be obtained upon request.

not, contrary to Chowdhury's (1983) hypothesis, vice versa. Therefore, we use infant mortality rates as the dependent variable and fertility rates as one of the independent variables.

III. THE EMPIRICAL MODEL AND RESULTS

The paper uses a cross-section data set (1993) for the empirical analysis. The observations are 117 low, middle, and high income countries, taken from all 6 continents.

The dependent variable is infant mortality rate (IMR). The following is the empirical specification:

$$IMR_i = \beta_0 + \beta_1\ FERTILITY_i + \beta_2 LNGNP_i + \beta_3 LABOUR_i + \beta_4 LABOUR_i^2 + \beta_5 LITERACY_i + \beta_6 \mathrm{HEALTH}_i + \varepsilon_i \quad (1)$$

where i = 1,2, . . . ,117 (countries in the sample are listed at bottom of Table 1).

As mentioned before, fertility rates affect infant mortality rates in a positive way; the variable parameter β_1 is therefore expected to be positive. The variable *LNGNP* (the natural logarithm of per capita GNP) is used to capture a tapering-off effect of GNP on IMR. The coefficient β_2 is hypothesized to be negative implying that an increase in income decreases *IMR* at a decreasing rate.

Female participation in the labour force could conceivably have a quadratic relationship with *IMR*, thus resulting in the usage of the variables *LABOUR*, and *LABOUR*^{2}. Accordingly, β_3 should have a positive sign; whereas, β_4 should have a negative sign. Initially as female participation in the labour force increases, *IMR* increases owing to lack of childcare services. After a point, *IMR* starts to decrease with the concurrent economic development brought about by increased female participation in the economy.

The variable *LITERACY* measures the female literacy rate. We have chosen female literacy because educated mothers are more likely to be aware of nutrition and their children's health (Gubhaju, 1986). Thus, β_5 is expected to be negative. Similarly, β_6 is expected to be negative. This is because an increase in *HEALTH* (expenditure on health care as percentage of GNP) implies a broader access to health care and services which helps decrease infant mortality.

The model was run (after correcting for heteroscedasticity[2]), and all coefficients, with the exception of *HEALTH* and *CONSTANT*, were significant at less than 1% level. Generalized Least Squares regression results along with sample means are displayed in Table 1. It can be noted from the $\bar{R}^2$ value of 0.8985 that the estimated equation is a very good fit. As hypothesized, fertility rates (*FERTILITY*) and infant mortality rates (*IMR*) are positively correlated; a 10% increase in fertility rates increases infant mortality rates by 8.2%. Furthermore, a 10% increase in *GNP* decreases *IMR* by 1.4%, *ceteris paribus*.

The coefficients for *LABOUR* and *LABOUR*^{2}, 4.135 and –0.046041, respectively, are very significant, verifying our beliefs that a quadratic relationship exists between female participation in the labour force and infant mortality rates. A

Table 1. *Generalized least squares regression results and sample means*

Dependent variable: *IMP* [Mean = 44.983]

Variable	Estimated coefficient	*t*-ratio 110 DF	Mean	Elasticity at means
FERTILITY	10.812	7.848	3.5556	0.8201
LNGNP	–6.998	–3.134	8.2585	–0.1414
LABOUR	4.135	3.359	40.051	0.3980*
LABOUR^2	–0.46041E–01	–2.847	1661.5	–
LITERACY	–0.48684	–6.707	74.339	–0.7069
HEALTH	–0.28218	–0.370	1.9113	–0.0278
CONSTANT	10.353	0.3022	–	–

$\bar{R}^2$ = 0.8985
Sample size = 117

Notes: variable definitions:

IMR = infant mortality rate – number of deaths before age I per 1000 live births.

FERTILITY = number of births per woman.

LNGNP = the natural logarithm of per capita GNP in purchasing power parity (1993).

LABOUR = percentage of women in the labour force.

LITERACY = female literacy rate.

HEALTH = expenditure on health care as percentage of GNP.

* Computed as

$$\left[\frac{\partial IMR}{\partial LABOUR} = \beta_3 + 2\beta_4 LABOUR\right] \cdot \frac{LABOUR}{IMR}$$ evaluated at the sample means.

Countries used in sample:

Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Bangladesh, Belarus, Belgium, Benin, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Congo, Costa Rica, Cote d'lvoire, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, The Gabon, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Haiti, Honduras, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyz Republic, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Moldova, Morocco, Nepal, The Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Rwanda, South Korea, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, United Kingdom, Uruguay, United States of America, Uzbekistan, Venezuela, Vietnam, Zambia, Zimbabwe.

[2] To conserve space tests for heteroscedasticity have not been included but can be obtained upon request. The factor of proportionality used to neutralise heteroscedasticity is $(LNGNP)^{1/2}$.

10 percentage point increase in *LABOUR*, increases IMR by about 4% at the sample means. Female literacy rates also have a significant effect on infant mortality rates; a 10% increase in *LITERACY* causes *IMR* to decrease by approximately 7%. Finally, while expenditure on health as a percentage of GNP (*HEALTH*) has a negative impact on infant mortality rates, the effect of the expenditure is statistically insignificant.

IV. SUMMARY AND CONCLUSION

This communication studied the impacts of fertility rates, female participation in the labour force, per capita GNP, female literacy rates, and government expenditure on health as a percentage of GNP on infant mortality rates. Results, based on 117 countries for the year 1993, and after adjusting for heteroscedasticity, indicate that with the exception of expenditure on health programmes, all other factors significantly affect infant mortality rates. However, our findings contradict Chowdhury's (1988) theory that there is a dual causality between infant mortality rates and fertility rates, but demonstrate that fertility rates do have an effect on infant mortality rates.

Furthermore, of all the independent variables, fertility rates and female literacy rates have the strongest impact on infant mortality rates. Hence, these factors should be given prime importance when developing programmes to curb infant mortality.

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APPENDIX: DATA SOURCES

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